



1997 Stakeholders Report

A Report to the American People

NASA LANGLEY RESEARCH CENTER

NASA Vision

NASA is an investment in America's future.

As explorers, pioneers and innovators,
we boldly expand frontiers in air and space
to inspire and serve America and
to benefit the quality of life on Earth.

Langley Mission

In alliance with industry, other agencies and academia,
we develop airframe and synergistic spaceframe
systems technologies to assure preeminence of
the U.S.civil and military aeronautics and space industries;
in alliance with the global research community,
we pioneer the scientific understanding of
the Earth's atmosphere to preserve the environment.

NASA Langley ’s Stakeholders

*This report has been prepared for
NASA Langley’s Stakeholders:
the American taxp ayers
and, therefore, owners of the government,
of NASA and of NASA programs.
Specifically they include:*

- General public*
- Members of the White House and Congress*
- Key national decision makers*
- Industry and educational partners*
- Customers who implement our technology*





I am pleased to offer you, our stakeholders, this report on recent NASA Langley Research Center priorities and accomplishments.

As you are aware, the Federal government is undergoing change. The American people have made it very clear that you want a smaller, less expensive government. NASA is responding to your challenge. Let me assure you, the Langley Research Center places great importance on giving you, the taxpayer, the greatest value for your investment.

At NASA Langley our most important job is to develop technologies to enable safer, cleaner and more affordable air travel. We are working to make aircraft more maneuverable, quieter, more energy efficient and cheaper to manufacture, maintain, and fly. In addition to improved aircraft, our goal is increased safety and convenience for the public. We are proud of our leadership role in aeronautics. We manage the Agency's efforts in aviation safety, airframe systems, advanced subsonics, high-speed research, advanced space transportation and hypersonic propulsion. In partnership with NASA's research centers around the country, we are confident that we can help this country remain competitive in the global aeronautics marketplace.

In addition, we are doing significant work to support the Nation's space programs. Knowledge gained from space research is changing daily life dramatically. Langley manages a dynamic atmospheric sciences program in which we provide critical support to national and international efforts to study the atmosphere of our home planet and the impact of human activity on it. And, we are contributing to the development of advanced space transportation and the spacecraft of tomorrow. We are working to reduce launch and operational costs of future missions as well as the cost and development time for future space transportation vehicles.

In 1997, this Center celebrated our eightieth anniversary. We have a long legacy of contributions to the Nation but our focus is, and has always been, the future. The research being done here helps America maintain its position of leadership in the multibillion dollar aerospace industry. It helps America offer high-tech employment to nearly one million workers across the country. It helps provide a positive return on your investment in NASA.

I invite you, our Stakeholders, to review our report to the American people. For additional information on current Langley programs and future thrusts, I also invite you to visit us on the World Wide Web at <http://www.larc.nasa.gov/>

J E R E M I A H F . C R E E D O N
D i r e c t o r



History

For 80 years, NASA's Langley Research Center has occupied a special place in the Nation's aeronautics and space history. Opened in 1917 as the first research facility of NASA's predecessor, the National Advisory Committee for Aeronautics (NACA), Langley was primarily responsible for nursing U.S. aviation from infancy to world leadership.

The Wright brothers had given this country the early lead with their historic flight in 1903. By World War I, however, that edge had been lost to German, British and French aviation advances. One of the NACA's first steps toward regaining air superiority was to establish a research center for aviation.

Our Hampton, Virginia, site fit all the criteria – it was close to the water, not far from Washington, and inexpensive. The Langley lab's first mission was forthright: to find practical solutions to the problems of flight.

With the birth of NASA in 1958, Langley added another unique dimension – this time as a leader in the Nation's fledgling space program. Who could have imagined that Neil Armstrong and his colleagues would practice lunar landings in what had once been a cow pasture.

Or that, on the historic Chesterfield Plantation, Langley scientists would learn how to break the grasp of gravity and orbit the Earth.

This Center has a proud history and a long list of technological firsts. Langley hired and trained generations of scientists, engineers, technicians and managers – in short, many of this country's aerospace leaders. In the process, Langley helped establish our nation's aeronautics and space infrastructure.

Langley's talented people broke technological barriers and created an inventory of aerospace research tools. They contributed to the establishment of aerospace departments at universities throughout the Nation. In doing so, they helped set up this country's aviation and space industries.

Langley men and women are continuing to make commercial, military and general aviation aircraft safer and more efficient. They are enabling the citizens of the world to learn about this complex planet we call home. In short, they are making air travel and space exploration a part of everyday life.

A National Resource

NASA Langley is an important national resource, with a wide array of wind tunnels, laboratories, flight simulators, scientific computing capabilities and research aircraft housed in more than 200 buildings on nearly 800 acres. If the Center were to be replaced today, the facilities alone would cost more than \$2.2 billion.



WIND TUNNELS

NASA Langley has been a recognized world leader in the creation, design, construction and use of wind tunnels and wind tunnel technology for 80 years. The wind tunnels at Langley helped this country become the global leader in both military and civilian aviation. Today, the Center has 31 operational wind tunnels, which supported research for approximately 60,000 hours in fiscal year 1997. The tunnels cover the speed range from zero mph to nearly Mach 25, or about 17,500 mph – the velocity needed to escape the Earth’s atmosphere. Many of these tunnels are the only ones of their kind in the United States. The tunnels are used to test scale models of aircraft and spacecraft to gather information about their aerodynamic performance. Some tunnels are used to obtain data about the aerothermodynamics of flight vehicles, such as the space shuttle or the X-33 and X-34 next-generation launch vehicles now under development.



LABORATORIES

In addition to wind tunnels, NASA Langley operates a variety of other research laboratories, computer systems and simulators as well as shops where wind tunnel models and other devices are fabricated. For example, new composite materials are developed on Center, made into structures in the Composite Materials Laboratory and tested in the Structures and Materials Laboratory. Efforts to reduce noise levels in aircraft are underway at the Acoustics Research Laboratory. Researchers are developing ways to inspect aircraft and other structures non-invasively in the Nondestructive Evaluation Techniques Laboratory. There is even an outdoor laboratory, the Impact Dynamics Research Facility, where airplanes are crash-tested in an effort to improve crashworthiness.



RESEARCH AIRCRAFT

Through the years, Langley has relied on a wide variety of aircraft to conduct flight research, much of it in cooperation with NASA Dryden Flight Research Center in Edwards, CA. For instance, Langley’s 737 flying laboratory was extensively used to develop technologies that helped aircraft fly more safely and effectively. The recently decommissioned 737 has been replaced by a Boeing 757 that is being extensively refitted to serve as NASA’s new flying lab. As the number of research aircraft at Langley is reduced, the center’s extensive simulation capability is being built up. The newest simulation facility will have four interchangeable cockpits that will function independently on their fixed base or be integrated with a shared motion base. The new facility is expected to be operational in 1998.

The next time you step aboard an airplane, be aware that it incorporates some technology developed at NASA Langley. The fuselage may contain composite materials that make the aircraft lighter and more fuel efficient, yet stronger. It may feature advanced cockpit technologies that are more user-friendly to pilots – and safer for you. Or it may have aerodynamic design characteristics that let the plane fly through the air more efficiently.

Yet, few people realize that the first “A” in NASA stands for Aeronautics. In fact, 70 percent of the work at NASA Langley is devoted to aeronautics. From small private planes to large passenger airliners, Langley researchers are working on ways to help make the Nation’s airplanes safer, more efficient, more affordable, quieter and easier to fly.

This is particularly important in the face of projections indicating that demand for air travel will triple in the next two decades. The technologies being developed by NASA not only make flying safer and more efficient – they help the United States remain competitive in a global marketplace. Little more than 20 years ago, the U.S. dominated large commercial transport manufacturing, a position that has since eroded. Still, American-made aviation products remain the largest positive industrial contributor to the U.S. balance of trade. New technology development is part of the equation that will help the Nation thrive.



A I R C R A F T S A F E T Y

For the past 80 years, NASA Langley has played a vital role in ensuring that flying is the safest way to travel. From aging aircraft to wind shear, technology developed here in partnership with U.S. industry promises to save lives around the globe. Aging aircraft will fly safer and longer because of new nondestructive methods to find structural disbonds, cracks and corrosion. In a growing number of aircraft, pilots now have up to 30 seconds advance warning of dangerous microbursts – sudden shifts in wind direction spawned by severe weather – as a result of Langley research that led to the development of wind shear sensors. In 1997, Langley was selected to lead a national aviation safety initiative whose goal is to significantly reduce the aircraft accident rate.

N O I S E R E D U C T I O N

Airports are operating with increasingly stricter noise standards and curfews, potentially restricting airline operations. NASA Langley, Ames and Lewis Research Centers, in partnership with the FAA and industry, are developing technologies to enable U.S. airlines to comply with international environmental requirements and allow unrestrained market growth. The goal is to cut the perceived noise emitted by subsonic transports in half by improving engines, aircraft systems and aircraft operations.

P E R S O N A L A I R T R A V E L

Under Langley leadership, new life is being injected into the ailing general aviation industry by the cooperation of the members of the Advanced General Aviation Transport Experiments (AGATE) consortium. This unique partnership of government, aviation industries and universities promises to bring the best each has to offer. Together they hope to make single-engine aircraft an efficient alternative to automotive travel for intercity transportation. Emerging technologies offer breakthroughs in safety, affordability and ease-of-use for small aircraft.

M I L I T A R Y

Nearly every U.S. military aircraft has been tested in Langley wind tunnels. This research has improved various aspects of their performance, such as maneuverability and high-angle-of-attack capabilities. As just one example, the fuselage shape of today’s fighter jets is a Langley innovation that was designed to overcome early barriers to supersonic flight.



ADVANCED AIRCRAFT CONCEPT

Langley has long been a key contributor to advanced aircraft concept development through innovative research to assess critical enabling technologies. One example of an unconventional aircraft design is the "flying wing." Langley researchers, in a team effort with industry and academia, have been studying an airplane that would carry up to 800 passengers more than 7,000 miles in a double-deck compartment that blends into the wing itself. The advantage of the design comes from maximizing overall efficiency by integrating the engines, wings and body into a single lifting surface. This concept will combine advances in structures, aerodynamics and other technologies that could offer dramatic advantages over current aircraft.



HYPER - FLIGHT

NASA is always searching for ways to fly higher, faster and farther. In the Hyper-X program, the boundaries of high-speed flight will be expanded when unpiloted, 12-foot-long aircraft fly up to 10 times the speed of sound, or 7,200 miles per hour, between now and the end of the decade. Working with NASA Dryden, Langley seeks to demonstrate "airbreathing" engine technology that scoops oxygen directly from the air, eliminating the need for heavy oxygen tanks. A Hyper-X-type aircraft is potentially more efficient than rocket-powered flight while carrying more payload.



FASTER FLIGHT

NASA Langley, Lewis, Ames and Dryden Research Centers are working together to help develop technologies for an airplane that would carry 300 passengers at 2.4 times the speed of sound. This breakthrough will cut in half the travel time across the oceans and add 140,000 U.S. high-tech jobs. Many technological barriers need to be overcome before such an aircraft is economical and environmentally acceptable. The NASA High-Speed Research Program, managed by Langley, successfully completed research in several important areas: atmospheric effects, community noise, aerodynamics and flight deck. This Center also developed the outside skin material that withstands temperatures generated at supersonic flight.

From America's space shuttle, to the next-generation launch vehicle, to the ozone hole, NASA Langley plays a key role in the Nation's space and atmospheric-sciences programs. This research is vital, as the space frontier is increasingly a busy crossroads of U.S.-led international science, research, commerce and exploration. About 30 percent of Langley's effort is space-related.

NASA Langley is an Agency leader in atmospheric studies. Using aircraft, satellites and other research methods, Langley conducts an aggressive research program focused on global change. Our goal is to improve the understanding of natural and human-induced changes in Earth's atmosphere.

Langley also supports the Nation's space programs with research in advanced aerospace transportation systems, advanced spacecraft, remote sensing applications and spaceflight projects.



NEXT - GENERATION SPACECRAFT

Since 1958 when NASA was created, Langley has been a leader in the space program, from Project Mercury to one of the latest projects – a next-generation launch vehicle. Langley is working with industry partner Lockheed Martin and other NASA centers to develop the X-33 Reusable Launch Vehicle as a demonstrator of the technologies that could be used in a future spacecraft. Langley is bringing to the X-33 its expertise in composite structures and materials, vehicle systems analysis, aerothermodynamics, aerodynamics, wind tunnel testing and flight control technology.

SHUTTLE AND MIR

Langley's space technology researchers are using the U.S. space shuttle and the Russian Mir space station to study how structures and materials behave in space. Their experiments will provide the designers of future space vehicles with much-needed information. We need to know the type and amount of debris found in low-Earth orbit, how astronaut or instrument movements can cause vibrations throughout a space vehicle or space station. Additionally, it is important to determine how solar arrays are affected by shuttle/space station rendezvous and to learn more about the heating and cooling cycles of low-Earth orbit.

EXPLORING SPACE

Langley contributes regularly to the development of advanced spacecraft as part of an overall effort to reduce the size, cost and design-time for missions. For example, in support of the NASA Pathfinder mission to Mars, Langley engineers helped develop the flight software and the heat shield that enabled the Pathfinder probe to land safely on Mars in July 1997. A follow-on program, Mars Global Surveyor, is providing exciting new data, insight and images of Mars.

UNDERSTANDING THE ATMOSPHERE

Researchers at NASA Langley are pioneers in the study of global atmospheric chemistry. NASA's Global Tropospheric Experiment is gathering more than 100 scientific measurements in a wide variety of ecosystems via sensors on board aircraft as well as from ground stations. In addition, Langley researchers develop tools for probing the atmosphere. These include LITE, the first laser for measuring the atmosphere from space, and LASE, the first autonomous aircraft-based lidar or laser radar. These measurement teams in partnership with Langley's atmospheric modeling team are helping explain the effect of human activities and natural events on Earth's atmosphere.



EXPLAINING THE OZONE HOLE

The Langley Halogen Occultation Experiment (HALOE), aboard the NASA Upper Atmosphere Research Satellite, is providing conclusive evidence that chlorofluorocarbons (CFCs) are the primary cause of ozone depleting materials in the atmosphere. More than six years of HALOE measurements are finding less hydrogen peroxide, a primary product of that chemical depletion, since the Montreal Protocol mandated reduced release of CFCs at the Earth's surface. In 1997, Langley launched the METEORS experiment that uses four independent techniques to measure ozone in the Earth's upper atmosphere.



THE ROLE OF CLOUDS

More than 50 percent of the Earth is covered by clouds at any one time. Thin, high clouds can trap heat emitted by the Earth, producing warming. Low, thick clouds can reflect the Sun's energy back into space, causing cooling. Using the CERES satellite experiment launched in late 1997, Langley researchers are studying the effect clouds have on our climate.



LASER TECHNOLOGY

Because of a breakthrough by Langley technologists, Earth scientists are now able to measure wind speed and direction from space. A laboratory demonstration system developed at Langley generated more than 10 times greater power than any previous 2-micron, eye-safe laser. As a direct result of this accomplishment, scientists and engineers will, for the first time, be able to measure global winds in an upcoming Shuttle-based experiment, chosen for NASA's highly competitive New Millennium Program.

The aerospace industry is a \$100 billion enterprise, offering high-tech employment to almost a million people in this country annually. Aerospace is the largest positive industrial contributor to the U.S. balance of trade. It is important to preserve the U.S. dominance in aeronautics and space which is being aggressively challenged by foreign competitors.

Langley Research Center’s staff of scientists, engineers, technicians and support personnel are making major contributions to our Nation’s aerospace technology program. The Center’s influence, however, extends beyond its technology contributions.

NASA Langley is a major contributor to the economies of the Virginia Peninsula, the Commonwealth of Virginia and the Nation. The Center has both financial and institutional impact on local and national companies, universities and colleges, regional small businesses and many non-profit organizations.

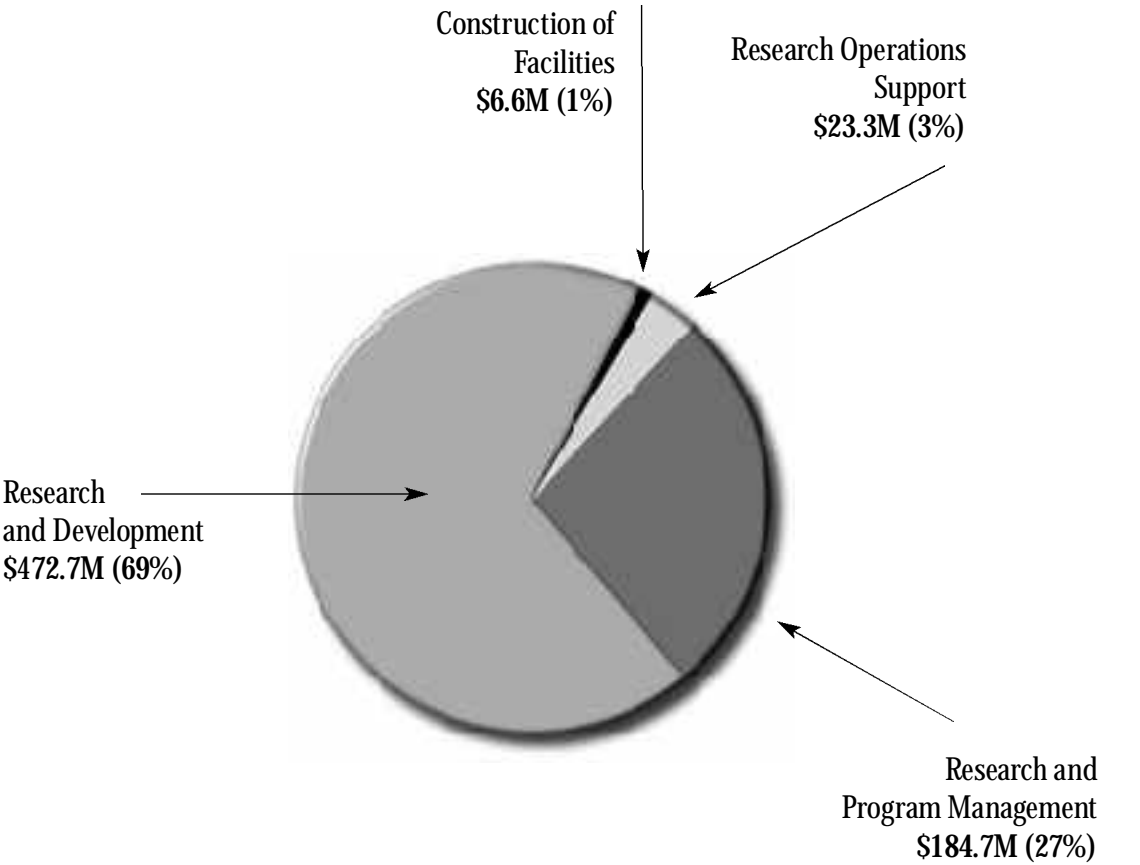
S T A F F I N G

Civil Service Workforce

Employees	2,408 Full time, permanent	
Skill Mix		
Scientific/Engineering	1,219	51 %
Administrative	308	13 %
Technical/Craft/Production	688	28 %
Clerical	193	8 %
Payroll	\$174M	

Contractor Workforce

Employees	1,457	
Contract Types	Research and Development Support Data Processing and Instrumentation Installation Maintenance and Operation Facility Operation and Maintenance Models and Fabrication	
Value of Contracts	\$150M	



Program Year 1997 Budget	
Research and Development	\$472.7M
Research and Program Management	184.7M
Research Operations Support	23.3M
Construction of Facilities	6.6M
TOTAL BUDGET	\$687.3M

Program Year 1997 Budget

C O N T R I B U T I O N S

N a t i o n a l E c o n o m y
\$512.2M

Contracts to Businesses	445.3
Non-Profit Institutions	19.8
Educational Institutions	47.1

V i r g i n i a E c o n o m y
\$233.0M

Contracts to Businesses	202.0
Non-Profit Institutions	15.0
Educational Institutions	16.0

H a m p t o n R o a d s E c o n o m y
\$193.7M

Contracts to Businesses	175.8
Non-Profit Institutions	8.6
Educational Institutions	9.3

NOTE: Figures do not include civil service and contractor payroll.

The President, Congress and the NASA Administrator continually emphasize the value of NASA's research to U.S. industry. NASA's goal is to help increase industrial competitiveness, provide jobs, contribute to a positive balance of trade and improve the quality of life.

Over the last decade, numerous high-technology businesses have formed on the Virginia Peninsula. NASA Langley is at the center of this rebirth, nurturing dozens of local small and mid-size start-ups. Many of these companies are dedicated to finding new commercial uses for aerospace technology.

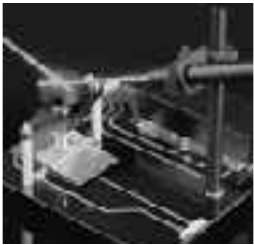
In a concerted effort to help create spin-off business, Langley has increased its focus on technology applications and commercialization of its research findings. With the development of its Technology Applications Group in 1994, Langley established a technology commercialization pipeline to assess, commercialize and track Center-developed innovations. To date, the Langley pipeline has taken 9 technologies through the characterization, partnership, commercial applications and licensing gates so that consumer products are now available in these areas. Further, out of the 10 NASA field centers, Langley received approximately 50 percent of all NASA royalties generated in 1997.

Fiscal Year 1997 Langley Accomplishments

Patented Technology		
	124	Invention Disclosures
	72	Patent Applications
	6	Foreign Patent Applications
	35	Patents Granted
Licenses Executed		
	16	
Commercial Programs		
	2	Involving 11 Companies
Space Act Agreements		
	39	Including 26 Non-Aerospace Companies
Publications		
	993	Reports, Memoranda, Journal Articles



This Langley-developed catalyst removes deadly carbon monoxide from the air and has commercial potential for home, hospital and school uses.



THUNDER, a technology breakthrough, could enable everything from speakers to heart pumps to be smaller and more efficient.



A new "superplastic," LaRC-SI™, has exciting commercial applications where high-strength and low-weight criteria are critical.

Education

The Langley Research Center views education as a broad continuum, from kindergarten through postdoctoral studies. The Center is committed to serve as an effective liaison between NASA and a wide range of educational institutions.



University Programs

NASA Langley contributed over \$40 million to universities across the country, awarding over 500 research and training grants, cooperative agreements and contracts to academic institutions in Fiscal Year 1997. In addition, the Center supported research and training totaling over \$8 million at Historically Black Colleges and Universities.

Equipment Donation to Schools

Under the Stevenson-Wydler Act, Langley Research Center transferred almost \$7 million in education-related federal equipment to 32 school districts primarily within a five-state area of Kentucky, North Carolina, South Carolina, Virginia and West Virginia. Over 2,400 items were donated, including computers and research equipment for use in mathematics and science curricula.

Educator Resource Center Network

In Fiscal Year 1997, Langley's Educator Resource Center Network disseminated over 100,000 products and served over 16,000 educators. The Langley Educator Resource Center is located at the Virginia Air & Space Center in downtown Hampton. Six Regional Educator Resource Centers are located within a five-state service area.

Spacemobile on Tour

NASA's Aerospace Education Services Program (AESP) specialists visited 1,200 teachers and over 37,400 students in the five-state service area.

The AESP specialists focus their efforts on teacher enhancement at the precollege level and provide workshops, demonstrations and classroom visits.

Partnership for Excellence in Math, Science and Technology

Langley's Partnerships Program has resulted in research and education activities at universities and precollege schools throughout America. These programs impact hundreds of businesses, industries and schools as well as hundreds of thousands of students.

National Engineers Week School Visitation

As part of the Center's commitment to encourage and prepare young people for life in a technological world, NASA Langley sponsors a school visitation program each February to celebrate National Engineers Week. In 1997, 132 employees and retirees visited 389 classes in 131 local schools, reaching nearly 10,500 students in this single effort to reinforce student interest in math, science and technology careers.

Distance Learning

Employing a variety of computer and information technologies, NASA Langley uses distance learning to promote educational excellence in the teaching of math, science and technology. The initiatives comply with national standards and make use of Langley's unique resources, facilities and personnel. In Fiscal Year 1997, over 900,000 students and teachers in grades K-12 participated in NASA Langley-sponsored Distance Learning programs.



Community Service

Langley Research Center employees are committed “beyond the gates” to activities that benefit the community. A survey of Center employees confirmed that close to 1,000 employees donate over 4 hours each week to volunteer efforts to help neighbors, newcomers and those in need.

COMBINED FEDERAL CAMPAIGN

NASA Langley has the highest participation rate and average gift of any major federal group on the Virginia Peninsula. In all,1,581 employees contributed nearly \$323,000 to the Peninsula Combined Federal Campaign.

BLOOD DRIVES

Giving the gift of life is one way Center employees reach out to the community. Langley Research Center sponsored six blood drives in Fiscal Year 1997. Civil servants and contractors donated 1,373 pints of blood to the Hampton Roads Chapter of the American Red Cross which serves the mid-Atlantic region.

SPEAKERS BUREAU

Langley’s Speakers Bureau provides a link with our most important customer, the American taxpayer. Center employees and retirees address civic, professional, educational and other non-profit organizations that want to learn more about the work done at NASA and at Langley. Over 125 presentations were made in Fiscal Year 1997, impacting a combined audience of almost 13,000 stakeholders.

TOURS

Langley Research Center offers a limited number of tours for public, professional, military, governmental and educational groups. Through these tours, our stakeholders are provided a first-hand look at how NASA research benefits them. Center personnel and volunteers hosted 92 tours for over 2,800 visitors to the Center. In addition, 26 tours were provided by the Center’s educational staff, impacting almost 700 teachers and over 600 students.

EMPLOYEE VOLUNTARISM

Just one example of numerous Center-supported outreach activities, the Community Day of Caring posted 170 Center volunteers at over 40 community sites. Whether they painted, pruned, plumbed or planted; sided, spackled, sorted or sawed; mowed, manicured or mended; cleaned, counted or cooked, the 1997 Day of Caring volunteers made the Peninsula a better place.

Telling the Langley Story

The Virginia Air & Space Center, NASA Langley’s visitor center, is a major tourist attraction. Featuring over 100 exhibits on history, aeronautics and space exploration, its theme “From the Sea to the Stars” integrates the region’s abundant history with Langley’s aerospace legacy. The Center has an IMAX theater featuring a five-story projection screen and a state-of-the-art sound system. Open since April 1992, the center has served over one million visitors. During Fiscal Year 1997, nearly 250,000 visitors toured the Virginia Air & Space Center.





Americans are calling for dramatic changes in government. Citizens want it smaller, less expensive, more productive. NASA has responded by reorganizing and restructuring its programs. The NASA strategic plan carries the theme of smaller-cheaper-faster all the way from satellite missions to the structure of the Agency itself. As NASA shapes its future, it intends to remain an investment in America's future. NASA is focusing on the development and application of new, cutting-edge technology to ensure the Nation's leadership in aerospace.

The international environment has also changed dramatically over the past several years. This country is moving into the next millennium in a true spirit of international cooperation in space exploration and research. Increased technologies in aeronautics are contributing to a safer, cheaper, more accessible future in flight. In the global marketplace, heightened competition underscores the need for advancements in U.S. technology to keep America at the top of the multibillion dollar aerospace industry.

In our future, NASA Langley plans to further develop relations with our customers and strategic partners. We intend to be a vital link between fundamental research done by universities and the strategic development and production done by industry. We must produce research and technology products not only for aerospace use, but also for the non-aerospace industry. We deem it critical that the private sector remain at the forefront for commercialization of these technologies.

We intend to continue to work closely with our stakeholders – the general public, our strategic partners and national decision makers – to select what research paths to pursue.

We take our charter to ensure U.S. aeronautical and space preeminence very seriously and are proud of the leadership role that has been entrusted to us.

Together with you, our Stakeholders, we can accomplish the following priorities:

- Maintain a leading role in developing aeronautics technology jointly with industry, academia and other government agencies.
- Continue to improve the safety and efficiency of the national air transportation system.
- Understand the Earth's environment and global change.
- Develop new capabilities for cheaper, more reliable access to space to support civil, national security and commercial goals.

World Wide Web Sites

Visit NASA Langley Research Center sites on the World Wide Web.

NASA Langley Research Center
<http://www.larc.nasa.gov/>

NASA Langley Economic Impact Document
<http://oea.larc.nasa.gov/org/impact/>

NASA Langley Technology Transfer Success Stories
[http://ntas.techtrans.org/4d.acgi\\$w3SureList\(LaRC\)](http://ntas.techtrans.org/4d.acgi$w3SureList(LaRC))

Information Guide to Research and Education Programs
<http://edu-www.larc.nasa.gov/edu/InfoGuide98/>

Virginia Air & Space Center, NASA Langley's visitor center
<http://seastar.vasc.mus.va.us/vasc/>



On the Cover

Few motorists realize that automobile travel is safer today because of a Langley research program. To increase airplane tire traction, Langley engineers studied hydroplaning — a loss of traction on wet surfaces — at the Aircraft Landing Dynamics Facility. The 50-ton carriage, shown on the cover, is propelled down the track at speeds of up to 250 mph to measure forces on aircraft landing gear and tires. Water from a sprinkler system wets the surface to produce conditions conducive to hydroplaning. The program verified the advantage of cutting grooves in the pavement surface to drain excess water. As a result of this study, every state in America has safety grooved at least part of its highway system.



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